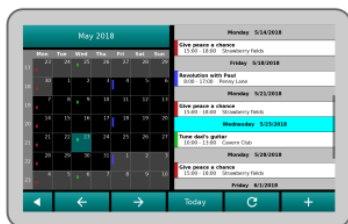
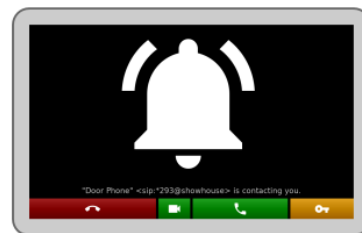
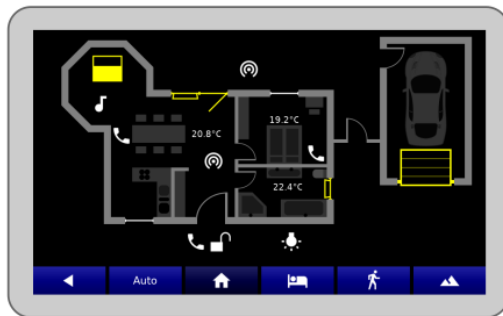


# The Home2Ls

*Clever Tools for a Private Smart Home*

*by Gundolf Kiefer*



[1]

```
# Turn on light for 5 secs. on motion
@onUpdate ("door/motion")
def LightOnMotion ():
    RcSetRequest ("door/light", "1 -5000")
```



## What are the *Home2Ls*?

The *Home2L* [*houmtu:l*] suite is a framework, library and set of tools for automation in private smart homes. Its main features are:

- ***Home2L Resources***: Novel concept to integrate and manage **sensors, actors or services of any kind efficiently and precisely**.
- **Automation rules written in Python** - but not limited to that,
- **Easy integration of services and new devices** - in C/C++, Python or by a shell script.
- ***Home2L Brownies***: Simple and efficient **automation bus to interconnect cheap 8-bit microcontrollers** for do-it-yourself sensor or actor hardware.
- ***Home2L WallClock***: **Lightweight, unobtrusive, concise, and responsive UI**, suitable to be installed on cheap tablets or minicomputers and mounted in all rooms - just like a wall clock.
- **Interactive floor plan** for all kinds of gadgets (windows, shades, lights, phones, computers, services, ...).
- **Video door phone** and **inter-room communication** (SIP-based).
- **Playing music** anywhere at home (MPD-based).
- **Family calendar** (in *WallClock*).
- **Docker image** and improved tutorial for getting started quickly.

## What is New?

- ***Home2L Brownies***: Simple and efficient **automation bus to interconnect cheap 8-bit microcontrollers** for do-it-yourself sensor or actor hardware.
- **Interactive floor plan** for all kinds of gadgets (windows, shades, lights, phones, computers, services, ...).
- **Docker image** and improved tutorial for getting started quickly

## How Can I Try It? Get More Information?

The main place of documentation is the [Home2L Book](#). The APIs for developing rules and drivers or to extend the *Home2Ls* are documented with Doxygen: [C/C++ API](#), [Python API](#).

The suite comes with a [Docker Demo Image](#) allowing to test the suite easily. The *Home2L Book* contains a **a step-by-step tutorial demonstrating the key features of the *Home2L* suite.**

### **For the brave and the impatient:**

```
$ xhost +local: # allow X11 applications to open windows
$ docker run -ti --rm \
  --name home2l-showcase --hostname home2l-showcase \
  -e DISPLAY=$DISPLAY -v /tmp/.X11-unix:/tmp/.X11-unix \
  --device /dev/snd \
  gkiefer/home2l
```

## **What is Noteworthy About the *Home2Ls*?**

### **Efficient and Lightweight Design**

All core components are written in C/C++, with a very minimum set of external dependencies beyond *libc* - ideally suited for small embedded devices and microcontrollers. There is no need for a Java runtime environment or a heavy web framework. Starting up a server and a command shell and shutting both down again takes less than a second altogether - on an ARM-based minicomputer running at 144 MHz!

The *Home2L WallClock* is written in native code (C++) and only uses *SDL2* for its UI toolkit. This makes it very portable and lightweight. Low-cost, low-performance minicomputers or Android tablets can be used as end-user devices, there is no need to install and regularly update a full-featured web browser on them.

### **Ambient Intelligence, No Need for a Central Server**

Central servers are single points of failure. *Home2L* follows a completely distributed concept. Any (mini-)computer can act as part of the network. If resources, such as sensors or actors, are connected to them, they can be exported to any other host in the *Home2L* network. A failure of a host only causes its own resources to be unavailable - everything else keeps on working.

### **Automation Rules Written in Python - But Not Limited to That**

There is no new language or tool to learn to formulate automation rules. *Home2L* rules are typically formulated in Python, they profit from the simplicity and power of the Python language. There can be multiple rules scripts, they may run on

any machine, and they may be combined with other software routines or be part of a larger application.

Other ways to interact with *Home2L* resources is via the C/C++ API from any application or by shell scripts using the *Home2L Shell* in non-interactive mode.

## Easy Driver Development in C/C++, Python or Any Other Language

An API for *resource* drivers allows to easily add support for new hardware. A driver can be implemented

- in native C/C++ code,
- as a shell script,
- in Python.

For all three cases, documented examples are available in the source tree.

## Easy Integration of Do-It-Yourself Hardware

*Home2L Brownies* are programmed low-cost microcontrollers (AVR *ATtiny 84/85/861*) connected to a Linux host over 4-wire cables (e.g. KNX/EIB cables). The bus protocol is based on *i2c*, robust and allows to build very simple, self-made hardware nodes. Just an *ATtiny* device and two resistors are enough to build a sensor node! Additional circuitry such as crystal clock generators, transceivers or voltage regulators are not necessary.

*Home2L Brownies* can drive, for example, window/door/light sensors (GPIOs), temperature sensors, or window shades/actuators.

The *Home2L* suite includes a software stack for the Linux (host) and for the microcontroller (device) side. The protocol includes various mechanisms for error correction/avoidance, host notification, as well as a variety of maintenance tools for remote configuration, diagnosis, collection of statistics, remote software updates, and device resurrection for the case that a software update failed and the device is difficult to reach physically.

## Versatile Resources Library

The central component of the *Home2L* suite is the *Resources* library. It manages physical sensors and actors, software services, computers and more. Everything that can act or sense in the widest sense, can be modelled as a *resources* in the *Home2L* suite.

All *resources* are arranged in a common namespace, but driven and accessed in a completely distributed way from any computer. They can be manipulated or

read out using the library, which provides full network transparency and supports arbitrary concurrent accesses from any process on any machine anytime.

Resources are manipulated by means of independent *requests* with individual attributes like priorities and time intervals. The user pushes a button to open the window shades. One second later, a timer-triggered automatic rule tells the shades to close. What should happen now? The *request* model allows to clearly specify the priority for the user (or against him, if desired) and to handle concurrency between automation rules and user interaction properly.

Both automation rules and resource drivers can also be part of a larger program. Any software linking against the *Resources* library can access resources or publish own run-time information as resources.

The *Home2L Shell* is a powerful administration tool and allows to access resources and submit requests on the command line or by shell scripts.

## Privacy

The *Home2Ls* do not need an Internet connection and do not try to communicate with hosts other than they are configured to. By design, the *Home2Ls* communicate with each other over a (trusted) LAN, which can easily be set up and secured using standard Linux/UNIX techniques. The open source licensing ensures transparency for what the software does inside the user's private home.

## Modularity

The core part, the *Resources* library, is kept small and portable with APIs for application programs *and* drivers in C/C++ and Python. All other components are optional and can be used or replaced by alternatives as desired by the user.

## How can I Help?

Until now, the *Home2L* project has been developed by a single private person in his spare time. The code has been published with the hope that is useful to the community.

To let the project grow further and make available to a broader audience, **volunteers and partners are welcome.**

Great contributions would be:

- **Report and help fixing bugs.**
- Make **sample installations**, document them and share your experiences.
- **Packaging**: Create packages for major Linux distributions.

- **Bridges to other home automation frameworks:** Help to implement drivers and interfaces with other open home automation frameworks.
- **Documentation:** Write good documentation, particularly for end users.
- **More drivers:** Implement drivers for any hardware you have or like. Help with an *MQTT* bridge would be appreciated, too.

For any questions on how to participate, do not hesitate to contact the author via the project page.

## Attribution

1. The doorphone video screenshot has been created using: ["The Beatles magical mystery tour"](#), Parlophone Music Sweden, [CC BY 3.0](#)